APPENDIX C

TEK TIPS
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Tek Tip

DENSITY vs. SPECIFIC GRAVITY

Density (D) -The mass (or weight) per unit volume of a material at a given temperature. Typical units are:

grams per cubic centimeter (g/cc or g/cm^3)
kilograms per cubic meter (kg/m^3)
pounds per cubic foot (lb/cu ft or lb/ft^3)
pounds per cubic inch (lb/cu in or lb/in^3)

Specific Gravity *(sp gr)* - AKA relative density. The ratio of the density of a material at a given temperature to the density of an equal volume of water at the same temperature. Units = none.

Test reference: ASTM D 792, D 1505

Density and specific gravity are both ways of describing the weight (mass) of a certain quantity of material. They are useful in determining yield and comparing different materials.

SO WHAT'S THE DIFFERENCE?

NOT MUCH. The main difference is that density has units and specific gravity does not. Why not? Specific gravity is determined by dividing the density of a material by the density of an equal volume of water *using the same units.* The units therefore cancel each other out. This means you don't have to worry about conversions when comparing materials that have densities using different units.

The specific gravity value of any given material is going to be the same in the US, Germany or China!
(Also, materials with a specific gravity of less than 1 will float on water)

The down side is that without units you can't do anything but compare different materials. It's hard to determine, for instance, the weight of a **100** sheet stack of **24" x 48", 0.010"** polycarbonate. This is where density comes in handy. The density of polycarbonate is **0.0433 lb/cu in.** In the above example the stack weighs about 50 lbs.

100 x .010" x 24" x 48" = 1152 cu in x 0.0433 lb/cu in = 49.88 lbs.

Fortunately, there is a loophole in the "no units" rule for sp gr. It just so happens that the density of water in grams per cubic centimeter (g/cc) is very close to 1 (0.9976). This means that the *specific gravity of a material is virtually the same as its density in g/cc.*

Material density g/cc ÷ 1 g/cc = material density = specific gravity

Therefore, knowing the specific gravity and with the help of the handy conversion table on the shared drive one can determine the weight* of any given quantity of material in almost any units. Example:

What is the approximate weight (in pounds) of 3000 - 25" x 38" sheets of .010" press polished, clear RPVC?

Specific gravity = 1.35 (from data sheet)
Density = 1.35 g/cc (based on loophole)
Density = 0.0488 lb/cu in (from conversion table)
Volume of material = 28500 cu in (3000 x .010"x 25"x 38")
Weight = 1391 lb (28500 cu in x 0.0488 lb/cu in)

* The weight will vary slightly due to small variations in film thickness and sp gr.

Another option, of course, for those materials that we currently sell, would be to use the Yield Conversion program also on the shared drive.

Here's a list of densities of some common plastics:

Type of Plastic	sp gr[1]	Density[1] g/cc	Density[1] lb/cu in
ABS	1.04	1.04	0.0376
acrylic (polymethylmethacrylate - PMMA)	1.19	1.19	0.043
cellulose triacetate (CTA)	1.30	1.30	0.047
cellulose acetate butyrate (CAB)	1.21	1.21	0.0437
polyamide (Nylon 6)	1.13	1.13	0.0408
polyamide (Nylon 12)	1.02	1.02	0.0368
polycarbonate (PC) Makrofol	1.20	1.20	0.0433
polyethylene naphthalate (PEN) Kaladex	1.36	1.36	0.0491
PET polyester Melinex, Mylar	1.40	1.40	0.0506
polyetherimide (PEI)	1.27	1.27	0.0459
low density polyethylene (LDPE)	0.91	0.91	0.0329
high density polyethylene (HDPE)	0.95	0.95	0.0343
polyimide (PI) Kapton	1.42	1.42	0.0513
polypropylene cast (PP)	0.89	0.89	0.0322
polypropylene biaxially oriented (BOPP)	0.905	0.903	0.0326
polystyrene (PS)	1.05	1.05	0.0379
rigid vinyl (RPVC)	1.35	1.35	0.0488
flexible vinyl cast	1.22	1.22	0.0441
polyvinyl fluoride (PVF) Tedlar	1.44	1.44	0.0520

[1] These values are approximations for comparison purposes. They will vary based on grade of resin and additives such as pigments and fillers. For greater accuracy use the value from the data sheet or specification on actual product.